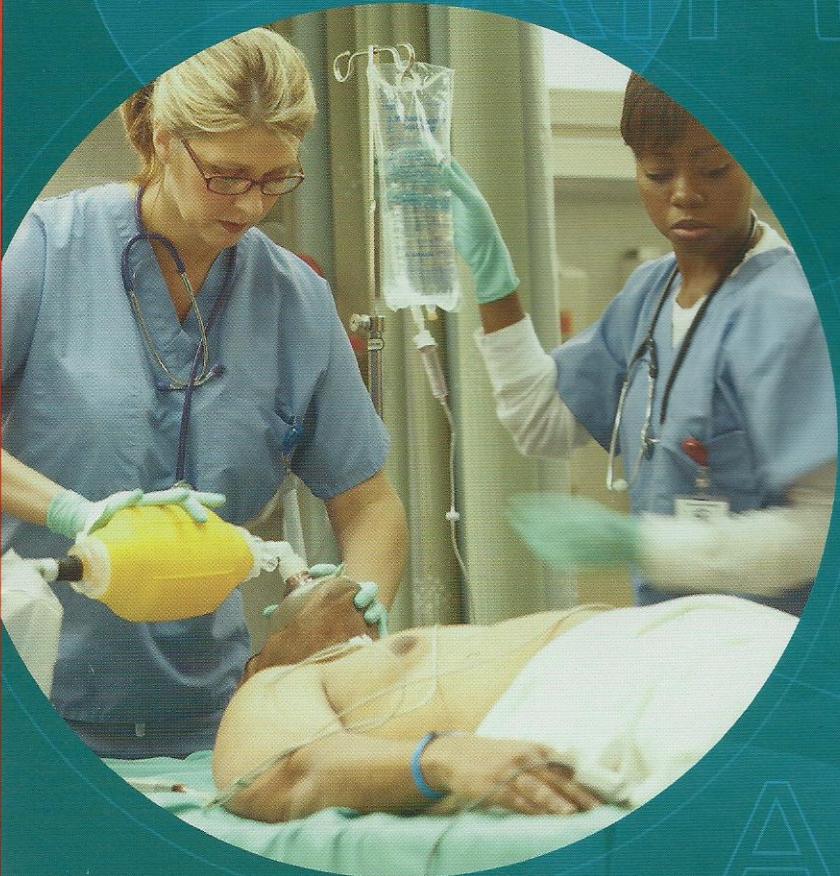
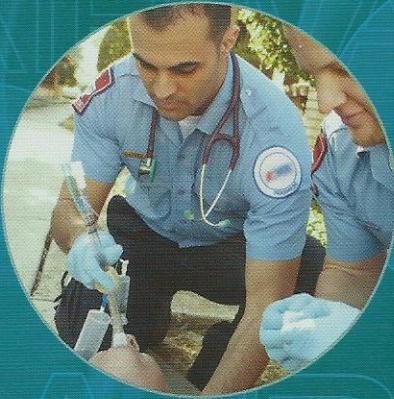


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# Airway Management

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STUDENT GUIDE



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دكتورة / رضا عبد الله منصور  
Dr. Reda A. Mansour

# AIRWAY MANAGEMENT

## STUDENT GUIDE

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## Introduction

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The American Heart Association Airway Management Course is designed for healthcare providers who must be proficient in using airway devices on adults in or out of hospital.

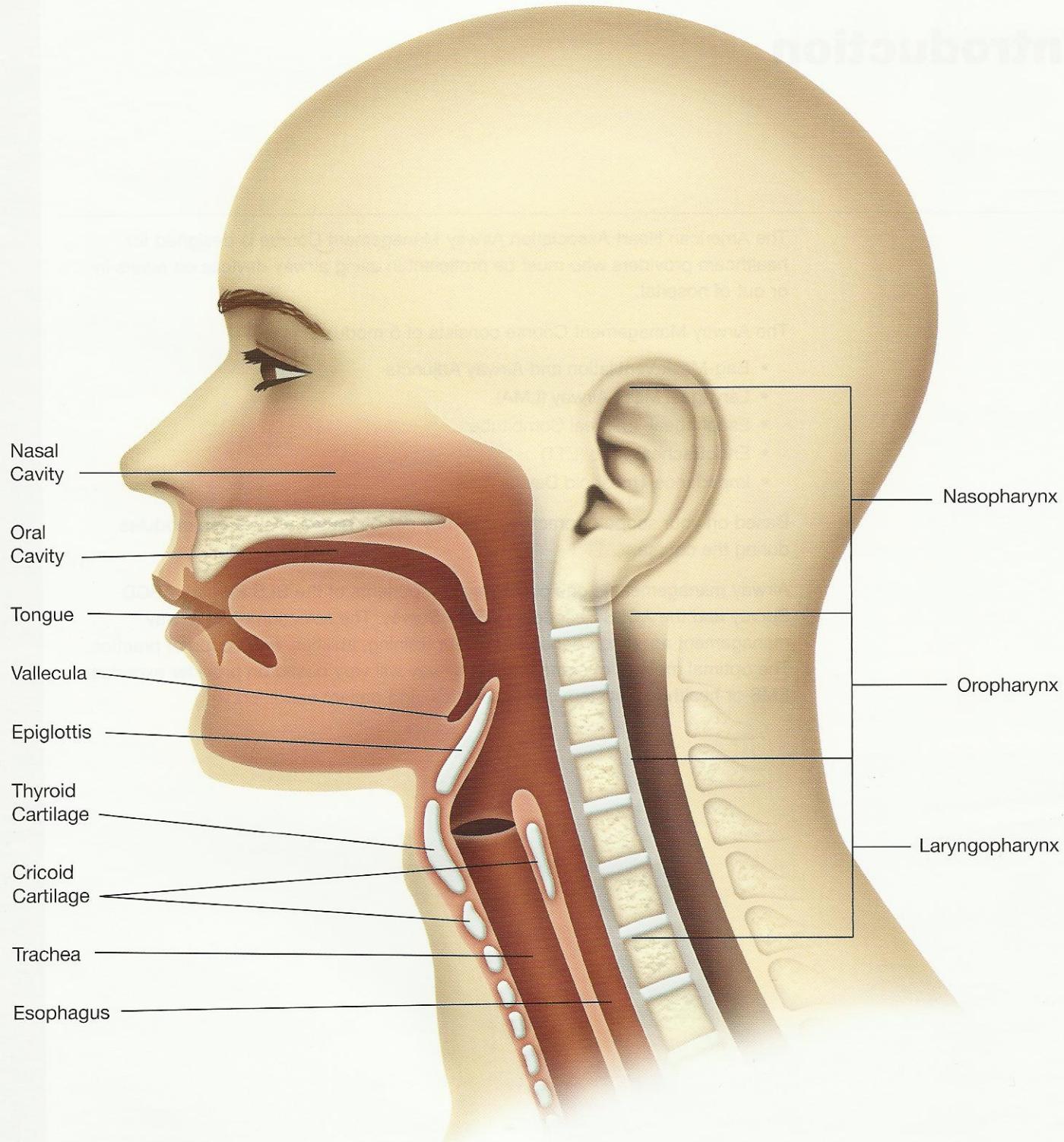
The Airway Management Course consists of 5 modules:

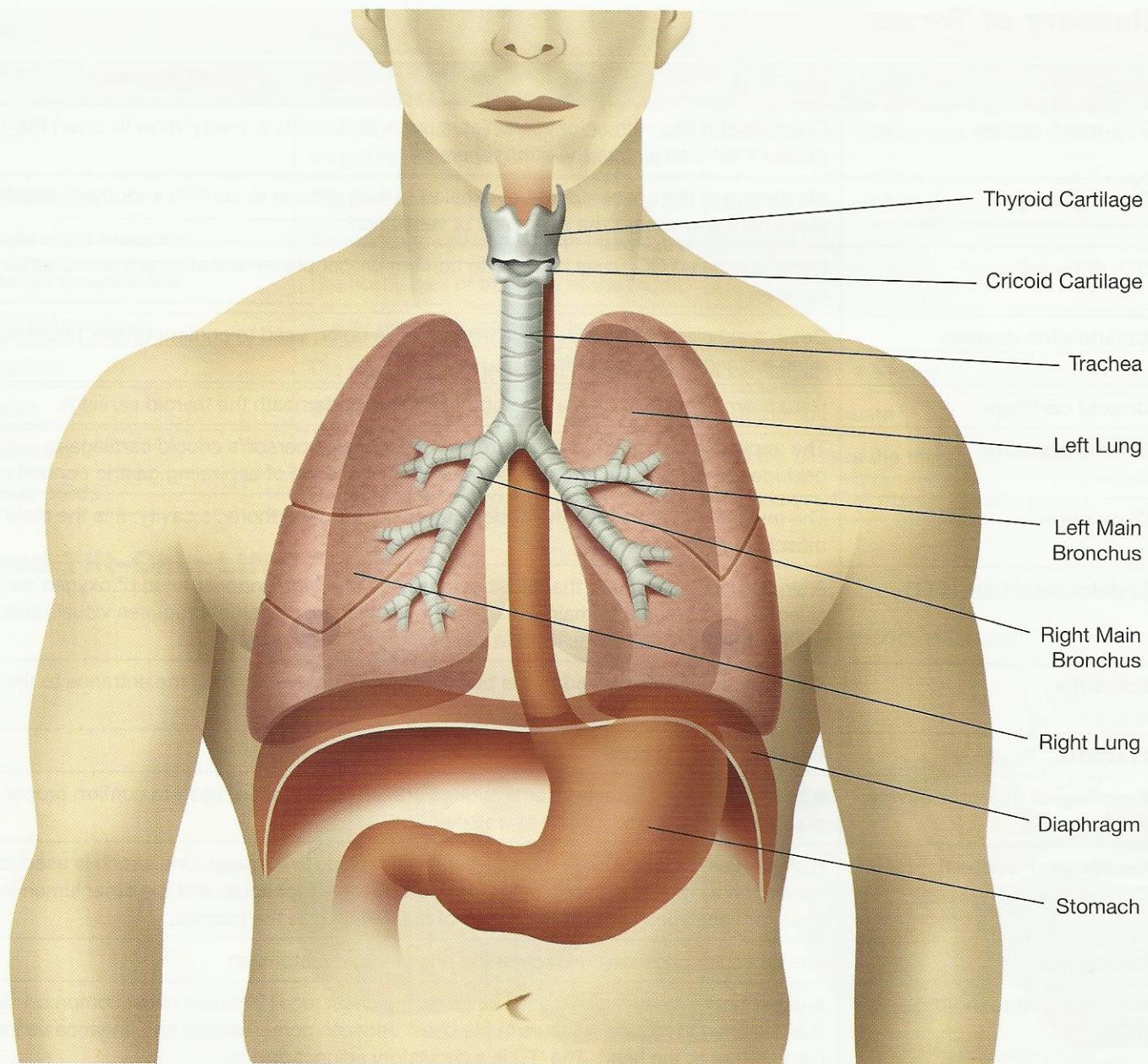
- Bag-Mask Ventilation and Airway Adjuncts
- Laryngeal Mask Airway (LMA)
- Esophageal-Tracheal Combitube
- Endotracheal Tube (ETT)
- Impedance Threshold Device (ITD)

Based on your scope of practice, you may not be taught all of these modules during the course.

Airway management is one of the key components of the BLS Primary ABCD Survey and the ACLS Secondary ABCD Survey. The selection of an airway management approach depends on your training, abilities, and scope of practice. The optimal method of managing the airway will vary based on provider experience, EMS or healthcare system characteristics, and patient condition.

## Airway Anatomy





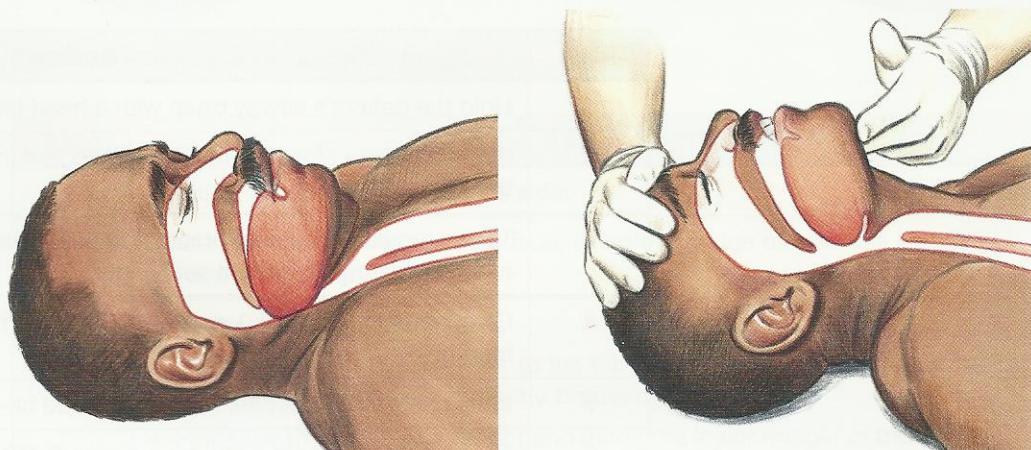
## Glossary of Terms

Term	Meaning
<b>Bag-mask device</b>	Consists of a bag with an oxygen inlet, a mask and, often, a 1-way valve to divert the patient's exhaled air into the atmosphere
<b>Capnography</b>	Monitoring of the concentration of exhaled carbon dioxide to confirm endotracheal tube placement and assess the adequacy of ventilation
<b>CO<sub>2</sub> detector</b>	Detects exhaled CO <sub>2</sub> ; may be used to confirm proper placement of an advanced airway device
<b>Colorimetric devices</b>	Detects exhaled CO <sub>2</sub> and displays the results in color; used to confirm proper placement of an advanced airway device
<b>Cricoid cartilage</b>	Hard prominence just below the soft depression underneath the thyroid cartilage
<b>Cricoid pressure</b>	The application of gentle pressure to an unresponsive person's cricoid cartilage to occlude the esophagus and reduce the patient's chance of aspirating gastric contents
<b>Diaphragm</b>	The muscle that separates the abdominal cavity from the thoracic cavity; it is the main muscle of respiration
<b>Endotracheal tube (ETT)</b>	A single-use, cuffed tube that facilitates delivery of a high concentration of oxygen and selected tidal volume to maintain adequate ventilation; placement requires visualization of the patient's vocal cords in most cases.
<b>Epiglottis</b>	A lid-like structure attached to the base of the tongue overhanging the entrance to the larynx; normally prevents food from entering the larynx
<b>Epistaxis</b>	Bleeding from the nose
<b>Esophageal detector device (EDD)</b>	A bulb or tube and attached large syringe that creates suction; used to confirm proper placement of some advanced airway devices
<b>Esophageal-tracheal Combitube</b>	A single-use, double-lumen tube for establishing a patent airway. One lumen is used for ventilation when the distal tip of the device is in the esophagus, and the other lumen is used for ventilation when the distal tip of the device is in the trachea.
<b>Esophagus</b>	The muscular passage connecting the pharynx to the stomach
<b>Impedance threshold device (ITD)</b>	A valve that limits air entry into the lungs during chest recoil between chest compressions; it is designed to reduce pressure in the chest between compressions and enhance venous blood return to the heart. The ITD is a circulatory adjunct device.
<b>Laryngeal mask airway (LMA)</b>	A tube with a cuffed mask-like projection at the distal end and a standard 15-millimeter adapter on the proximal end.
<b>Laryngopharynx</b>	The lower part of the pharynx
<b>Left main bronchus</b>	The passageway between the trachea and the left lung
<b>Nasal cavity</b>	The space behind the nose, extending from the nostrils to the pharynx
<b>Nasopharyngeal airway (NPA)</b>	A soft, curved hollow tube that can be inserted through the nostril to relieve upper airway obstruction and facilitate ventilation
<b>Nasopharynx</b>	The upper part of the pharynx, above the soft palate, that is continuous with the nasal passages
<b>Oral cavity</b>	The area of the mouth behind the teeth and gums

Term	Meaning
Oropharyngeal airway (OPA)	A J-shaped, curved, single-use disposable plastic device that holds the tongue away from the posterior wall of the pharynx. OPAs have a straight section or bite block that prevents clenching of the teeth and a distal, semicircular section that conforms to the curvature of the tongue and pharynx.
Oropharynx	The part of the pharynx between the soft palate and the epiglottis
Right main bronchus	The passageway between the trachea and the right lung
Thenar prominence	The fleshy part of the base of the thumb
Thyroid cartilage	The largest cartilage of the larynx
Trachea	The tube from the larynx to the bronchi that carries air to the lungs
Uvula	The small, fleshy pendant tissue at the back of the soft palate
Vallecula	The shallow groove between the epiglottis and the base of the tongue
Vocal cords	The 2 pairs of folded mucous membranes in the larynx that vibrate to make sound

## Head Tilt–Chin Lift

The head tilt–chin lift relieves airway obstruction in the unresponsive patient.



**Figure 1.** Head tilt–chin lift.

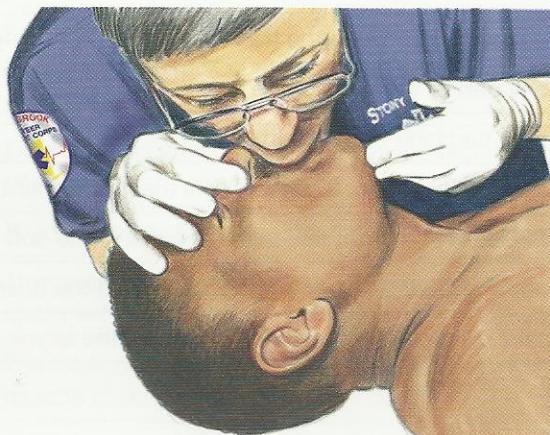
Step	Action
1	Place one hand on the patient's forehead and push with your palm to tilt the head back.
2	Place the fingers of the other hand under the bony part of the lower jaw near the chin.
3	Lift the jaw to bring the chin forward.

## Cautions

- Do not press deeply into the soft tissue under the chin because this might obstruct the airway.
- Do not use the thumb to lift the chin.
- Do not close the patient's mouth completely (unless mouth-to-nose breathing is the technique of choice for the patient).

## Mouth-to-Mouth Breathing

Mouth-to-mouth breathing is a quick, effective way to provide oxygen to the patient. The provider's exhaled air contains approximately 17% oxygen and 4% carbon dioxide. This is enough oxygen to supply the patient's needs.



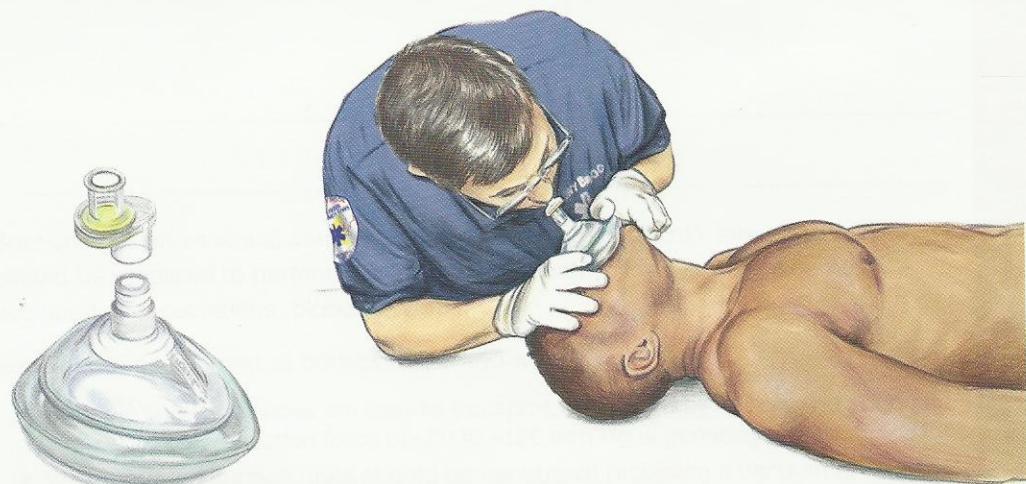
**Figure 2.** Mouth-to-mouth breathing.

Step	Action
1	Hold the patient's airway open with a head tilt–chin lift.
2	Pinch the nose closed with your thumb and index finger (using the hand on the forehead).
3	Take a regular (not deep) breath and seal your lips around the patient's mouth, creating an airtight seal (Figure 2).
4	Give 1 breath (blow for 1 second). Watch for the chest to rise as you give the breath.
5	If the chest does not rise, repeat the head tilt–chin lift.
6	Give a second breath (blow for 1 second). Watch for the chest to rise.

## Mouth-to-Mask Breathing

In mouth-to-mask breathing, you use a mask with or without a 1-way valve. The 1-way valve allows the provider's breath to enter the patient's mouth and nose and diverts the patient's exhaled air away from the provider. Some masks have an oxygen inlet that allows you to administer supplementary oxygen.

Effective use of the mask barrier device requires instruction and supervised practice.



**Figure 3.** Mouth-to-mask ventilation, 1 rescuer.

Step	Action
1	Position yourself at the patient's side.
2	Place the mask on the patient's face, using the bridge of the nose as a guide for correct position.
3	Seal the mask against the face: <ul style="list-style-type: none"><li>Using your hand that is closer to the top of the patient's head, place the index finger and thumb along the border of the mask.</li><li>Place the thumb of your other hand along the lower margin of the mask.</li></ul>
4	Place the remaining fingers of your hand closer to the patient's neck along the bony margin of the jaw and lift the jaw. Perform a head tilt–chin lift to open the airway (Figure 3).
5	While you lift the jaw, press firmly and completely around the outside margin of the mask to seal the mask against the face.
6	Deliver air over 1 second to make the patient's chest rise.

# Bag-Mask Ventilation and Airway Adjuncts

## Suctioning

Suctioning is an essential component of maintaining a patient's airway. Providers should be prepared to perform suctioning immediately if the airway becomes occluded with secretions, blood, or vomit.

Suction devices consist of both portable and wall-mounted units.

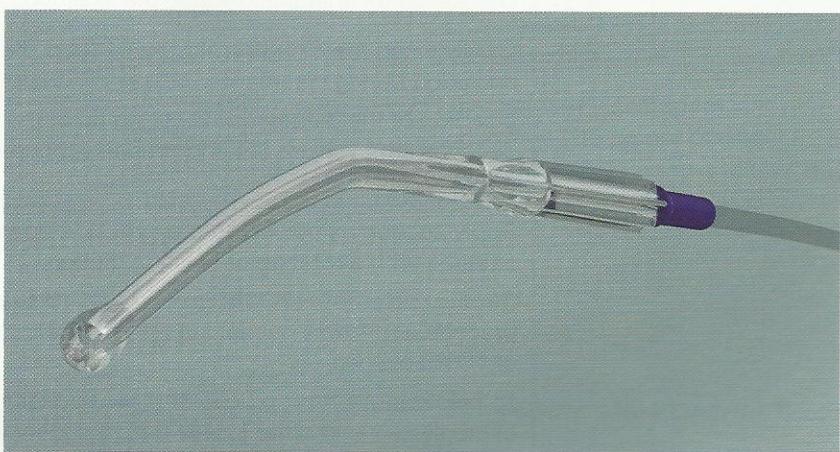
- Portable suction devices are easy to transport, but they may not provide adequate suction power. A suction force of  $-80$  to  $-120$  mm Hg is generally necessary.
- Wall-mounted suction units should be capable of providing a vacuum of more than  $-300$  mm Hg when the tube is clamped at full suction.

## Soft vs Rigid Catheters

Both soft flexible and rigid suctioning catheters are available.

*Soft flexible catheters* may be used in the mouth or nose. They can also be used for ET tube deep suctioning. Soft flexible catheters come in sterile wrappers.

*Rigid catheters* (eg, Yankauer) are used to suction the oropharynx. These are better for suctioning thick secretions and particulate matter.



**Figure 4.** Rigid catheter.

Catheter Type	Use for
Soft	<ul style="list-style-type: none"> <li>Aspiration of secretions from the oropharynx and nasopharynx</li> <li>Performing intratracheal suctioning</li> <li>Suctioning through an in-place airway (ie, NPA) to access the back of the pharynx in a patient with clenched teeth</li> </ul>
Rigid	<ul style="list-style-type: none"> <li>More effective suctioning of the oropharynx, particularly if there is thick particulate matter</li> </ul>

## Oropharyngeal Suctioning Procedure

Step	Action
1	<p>Gently insert the suction catheter or device into the oropharynx beyond the tongue.</p> <p>Measure the catheter before suctioning, and do not insert it any further than the estimated distance from the tip of the nose to the earlobe.</p>
2	<p>Apply suction by occluding the side opening while withdrawing the catheter with a rotating or twisting motion.</p> <p><b>Typically limit suction attempts to 10 seconds or less.</b> To avoid hypoxemia, precede and follow suctioning attempts with a short period of administration of 100% oxygen.</p>

*Monitor the patient's heart rate, pulse, oxygen saturation, and clinical appearance during suctioning. If bradycardia develops, oxygen saturation drops, or clinical appearance deteriorates, interrupt suctioning at once. Administer high-flow oxygen until the heart rate returns to normal and the clinical condition improves. Assist ventilation as needed.*

## Endotracheal Tube Suctioning Procedure

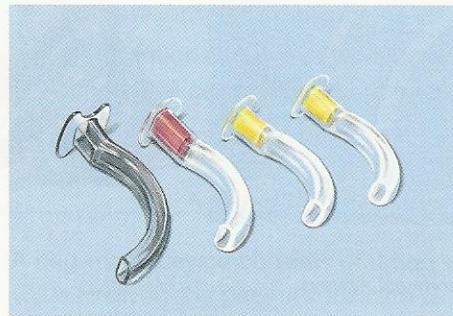
Step	Action
1	Use sterile technique to reduce the likelihood of airway contamination.
2	<p>Gently insert the catheter into the ET tube. Be sure the side opening is not occluded during insertion.</p> <p>Insertion of the catheter beyond the tip of the ET tube is not recommended because it may injure the endotracheal mucosa or stimulate coughing or bronchospasm.</p>
3	<p>Apply suction by occluding only the side opening while withdrawing the catheter with a rotating or twisting motion.</p> <p><b>Suction attempts should not exceed 10 seconds.</b> To avoid hypoxemia, precede and follow suctioning attempts with a short period of administration of 100% oxygen.</p> <p>To help remove thick mucus or other material from the airway, instill 1 or 2 mL of sterile saline into the airway before suctioning. Provide positive-pressure ventilation to disperse the saline throughout the airways for maximum effect before suctioning.</p>

*Monitor the patient's heart rate, pulse, oxygen saturation, and clinical appearance during suctioning. If bradycardia develops, oxygen saturation drops, or clinical appearance deteriorates, interrupt suctioning at once. Administer high-flow oxygen until the heart rate returns to normal and the clinical condition improves. Assist ventilation as needed.*

# Oropharyngeal Airway

An oropharyngeal airway (OPA) is a J-shaped, curved, single-use disposable plastic device that holds the tongue away from the posterior wall of the pharynx.

OPAs have a straight section or bite block that prevents clenching of the teeth and a distal, semicircular section that conforms to the curvature of the tongue and pharynx.



**Figure 5.** Oropharyngeal airways.

## When to Use

- Patient is unresponsive with no cough or gag reflex

## When Not to Use

- Patient is responsive
- Patient has a cough or gag reflex

## How to Use

Step	Action
1	<b>Clear the mouth and pharynx</b> of secretions, blood, or vomit using a rigid pharyngeal suction tip if possible.
2	<b>Select the proper size OPA.</b> Place the OPA against the side of the face. When the tip of the OPA is at the corner of the mouth, the flange is at the angle of the mandible. When the OPA is properly sized and inserted, it is in proper alignment with the glottic opening.
3	<b>Insert the OPA</b> so that it is turned <i>backward</i> as it enters the mouth.
4	As the OPA passes through the oral cavity and approaches the posterior wall of the pharynx, <b>rotate it 180 degrees</b> into proper position. An <b>alternative method</b> is to insert the OPA straight in while using a tongue depressor or similar device to hold the tongue on the floor of the mouth.

## Cautions/Additional Information

Be aware of the following when using an OPA:

- If the OPA selected is too large, it may obstruct the larynx or cause trauma to the laryngeal structures.
- If the OPA is too small or is inserted improperly, it may push the base of the tongue posteriorly and obstruct the airway.
- Insert carefully to avoid soft tissue trauma to the lips and tongue.

Remember to use the OPA only in the unresponsive patient with no cough or gag reflex. If the patient has a cough or gag reflex, the OPA may stimulate vomiting and laryngospasm.

## Nasopharyngeal Airway

A nasopharyngeal airway (NPA) is a soft, curved hollow tube that can be inserted through the nostril to relieve upper airway obstruction and facilitate ventilation.



**Figure 6.** Nasopharyngeal airways.

### When to Use

- Patient is awake or unresponsive
- Patient has a persistent cough or gag reflex

### When Not to Use

- Obvious occlusion of the nasal cavity
- Major epistaxis
- Presence of a clear fluid from the nose or ears, which could indicate a cerebral spinal fluid leak
- Severe cranial-facial injury

### How to Use

Step	Action
1	<b>Select the proper size NPA.</b> <ul style="list-style-type: none"><li>• Compare the outer circumference of the NPA with the inner aperture of the nares. The NPA should not be so large that it causes sustained blanching of the nostrils. Some providers use the diameter of the patient's smallest finger as a guide to selecting the proper size.</li><li>• The length of the NPA should be the same as the distance from the tip of the patient's nose to the earlobe.</li></ul>
2	<b>Lubricate the airway</b> with a water-soluble lubricant or anesthetic jelly.
3	<b>Insert the airway</b> through the nostril in a posterior direction perpendicular to the plane of the face. Pass it gently along the floor of the nasopharynx. If you encounter resistance: <ul style="list-style-type: none"><li>• Slightly rotate the tube to facilitate insertion at the angle of the nasal passage and nasopharynx</li><li>• Attempt placement through the other nostril because patients have different-sized nasal passages</li></ul>

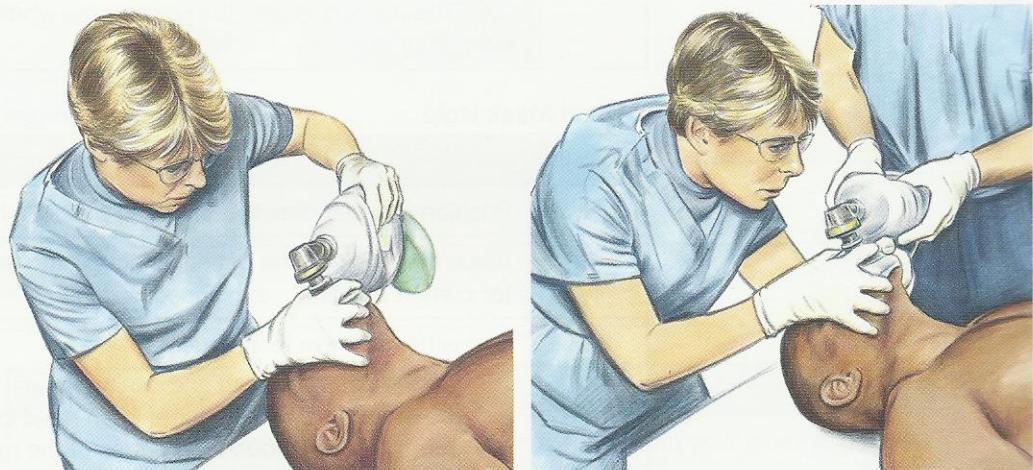
## Cautions/Additional Information

Be aware of the following when using an NPA:

- Take care to insert the airway gently to avoid complications. The airway can irritate the mucosa or lacerate adenoidal tissue and cause bleeding, with possible aspiration of clots into the trachea. Suction may be necessary to remove blood or secretions.
- An improperly sized NPA may enter the esophagus. With active ventilation, such as bag-mask, the NPA may cause gastric inflation and possible hypoventilation.
- An NPA may cause laryngospasm and vomiting even though it is commonly tolerated by semiconscious patients.
- Use caution in patients with facial trauma because of the risk of misplacement into the cranial cavity thorough a fractured cribriform plate.

## Bag-Mask Device

A bag-mask device consists of a bag with an oxygen inlet, a mask and, often, a 1-way valve to divert the patient's exhaled air into the atmosphere. It provides positive-pressure ventilation.



**Figure 7.** 1-rescuer and 2-rescuer use of a bag-mask device.

## When to Use

- During cardiac arrest
- During respiratory arrest
- Patient requires assisted ventilation

## How to Use

Select the appropriate size. A properly sized mask covers the patient's nose and mouth but not the eyes and chin. The wide portion of the mask must cover the lower lip but should not extend past the chin.

### 1-Hand Mask Hold

Step	Action
1	Position yourself directly above the patient's head.
2	Place the mask on the patient's face, using the bridge of the nose as a guide for correct position.
3	Use the E-C clamp technique to hold the mask in place while you lift the jaw to hold the airway open: <ul style="list-style-type: none"><li>• Perform a head tilt.</li><li>• Use the thumb and index finger of one hand to make a "C," pressing the edges of the mask to the face.</li><li>• Use the remaining fingers to lift the angles of the jaw (3 fingers form an "E") and open the airway.</li></ul>
4	Squeeze the bag to give breaths (1 second each) while watching for chest rise. The delivery of breaths is the same whether you use supplementary oxygen or not.

### 2-Hand Mask Hold

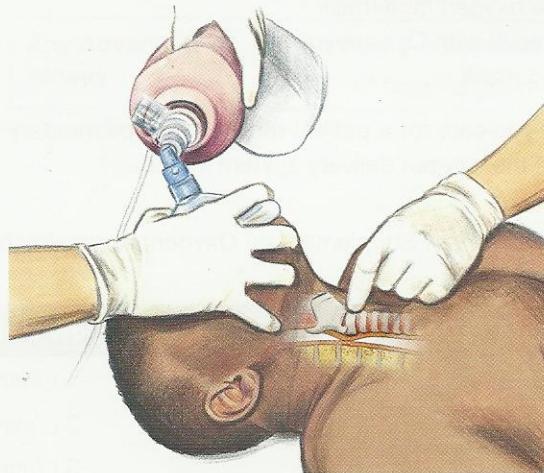
Step	Action
1	Position yourself directly above the patient's head.
2	Place the mask on the patient's face, using the bridge of the nose as a guide for correct position.
3	Use either of these techniques: <ul style="list-style-type: none"><li>• Lift the patient's head and seal the mask against the patient's face with the thumb and first finger of each hand creating a "C" to provide a complete seal around the edges of the mask. Use the remaining 3 fingers of both hands (the "E") to lift the jaw.</li><li>• Hold the mask in place with the thumb and the thenar prominence of the palm of the hands; use the remaining 4 fingers of both hands to lift the chin and open the airway.</li></ul>
4	Squeeze the bag to give breaths (1 second each) while watching for chest rise. The delivery of breaths is the same whether you use supplementary oxygen or not.

### Cautions/Additional Information

- If oxygen is available, connect it to the oxygen inlet of the bag. Oxygen flow to the bag should be set to 15 L/minute.
- Release the bag completely after each breath to allow the patient to exhale completely.

## Cricoid Pressure

Cricoid pressure, or Sellick's technique, is the application of pressure to the *unresponsive* patient's cricoid cartilage. The pressure pushes the trachea posteriorly, compressing the esophagus against the cervical vertebra. Cricoid pressure is effective in preventing gastric inflation during positive-pressure ventilation of *unresponsive* patients.



**Figure 8.** Cricoid pressure.

### When to Use

- Patient is unresponsive

### When Not to Use

- Patient is responsive

### How to Use

Step	Action
1	Locate the thyroid cartilage (Adam's apple) with your index finger.
2	Slide your index finger to the base of the thyroid cartilage and palpate the prominent horizontal ring below the thyroid cartilage (this is the cricoid cartilage).
3	Using the tips of your thumb and index finger, apply firm backward pressure to the cricoid cartilage.

### Cautions/Additional Information

Healthcare professionals should use the technique only when an extra rescuer is present who is not required to assist with breathing, chest compressions, or defibrillation. This means that if cricoid pressure were to be used during 2-rescuer CPR, at least 3 rescuers would actually be required:

- 1 or 2 rescuers to provide breaths
- 1 rescuer to perform chest compressions
- 1 rescuer to apply cricoid pressure

Oxygen administration is always appropriate for patients with acute cardiac disease or respiratory distress. Various devices can deliver supplementary oxygen from 21% to 100%, including

- nasal cannula
- simple oxygen face mask
- face mask with O<sub>2</sub> reservoir
- Venturi mask

Whenever you care for a patient receiving supplementary oxygen, quickly verify proper function of the oxygen delivery system in use.

**Table 1.** Delivery of Supplementary Oxygen: Approximate Flow Rates and Percentage of Oxygen Delivered.

Device	Flow Rates	Delivered O <sub>2</sub> *
<b>Nasal cannula</b>	1 L/min	21%-24%
	2 L/min	25%-28%
	3 L/min	29%-32%
	4 L/min	33%-36%
	5 L/min	37%-40%
	6 L/min	41%-44%
<b>Simple oxygen face mask</b>	6-10 L/min	35%-60%
<b>Face mask with O<sub>2</sub> reservoir (nonrebreathing mask)</b>	6 L/min	60%
	7 L/min	70%
	8 L/min	80%
	9 L/min	90%
	10-15 L/min	95%-100%
<b>Venturi mask</b>	4-8 L/min	24%-40%
	10-12 L/min	40%-50%

\*Percentage is approximate.

## Oxygen Supply

“Oxygen supply” refers to an oxygen cylinder or wall unit that connects to an administration device to deliver oxygen to the patient. When the patient is receiving oxygen from one of these systems, be sure to check the following equipment:

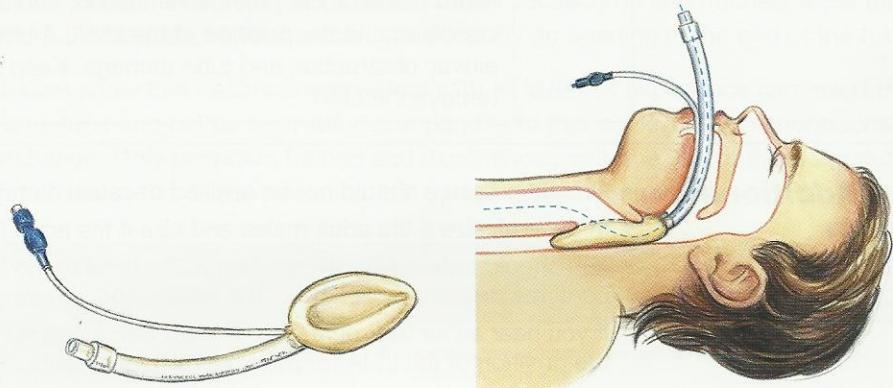
- valve handles to open the cylinder
- pressure gauge
- flow meter
- tubing connecting the oxygen supply to the patient’s oxygen administration device

## Ventilation Rates

Airway Devices	Ventilations During Respiratory Arrest	Ventilations During Cardiac Arrest
Bag-mask	<b>1 every 5-6 seconds</b> (10-12 breaths per minute)	2 ventilations after every 30 compressions
Any Advanced Airway	<b>1 every 5-6 seconds</b> (10-12 breaths per minute)	<b>1 every 6-8 seconds</b> (8-10 breaths per minute)

# Laryngeal Mask Airway

A laryngeal mask airway (LMA) is an advanced airway device that is considered an acceptable alternative to the ETT. The LMA is composed of a tube with a cuffed mask-like projection at the end of the tube.



**Figure 9.** Laryngeal mask airway.

## When to Use

- Patient is unresponsive with no cough or gag reflex

## When Not to Use

- Patient is responsive
- Patient has a cough or gag reflex

## How to Use

Step	Action
1	<i>Equipment preparation:</i> Check the integrity of the mask and tube according to the manufacturer's instructions. Lubricate only the posterior surface of the cuff to avoid blocking the airway aperture.
2	<i>Patient preparation:</i> Provide oxygenation and ventilation, and position the patient. Note that use of the LMA poses risks of regurgitation and aspiration in unresponsive patients, but studies have shown that regurgitation is less likely with the LMA than a bag-mask and that aspiration is uncommon. You must weigh these risks against the benefit of establishing an airway using this specific device.

(continued)

Step	Action
<b>3</b>	<p><i>Insertion technique:</i></p> <ul style="list-style-type: none"> <li>Introduce the LMA into the pharynx and advance it blindly until you feel resistance. Resistance indicates that the distal end of the tube has reached the hypopharynx.</li> <li>Inflate the cuff of the mask. Cuff inflation pushes the mask up against the tracheal opening, allowing air to flow through the tube and into the trachea.</li> <li>Ventilation through the tube is ultimately delivered to the opening in the center of the mask and into the trachea.</li> <li>To avoid trauma, do not use force at any time during insertion of the LMA.</li> <li>Never overinflate the cuff after inflation. Excessive intracuff pressure can result in misplacement of the device. It also can cause pharyngolaryngeal injury (eg, sore throat, dysphagia, or nerve injury).</li> </ul>
<b>4</b>	Insert a bite block, provide ventilation, and continue to monitor the patient's condition and the position of the LMA. A bite block reduces the possibility of airway obstruction and tube damage. Keep the bite block in place until you remove the LMA.

### **Cautions/Additional Information**

- Cricoid pressure should not be applied because it may hinder the insertion of the LMA.
- In general, size 5 fits adult males and size 4 fits adult females.
- You should note a smooth swelling at the level of the cricoid cartilage in the neck. This confirms proper positioning of the device and is normal.
- If you hear an air leak during ventilation with a bag for the next 3 or 4 breaths, reevaluate the position of the LMA for possible misplacement.
- To avoid displacement, limit the patient's head movement and avoid suctioning secretions in the pharynx once the LMA is in place.

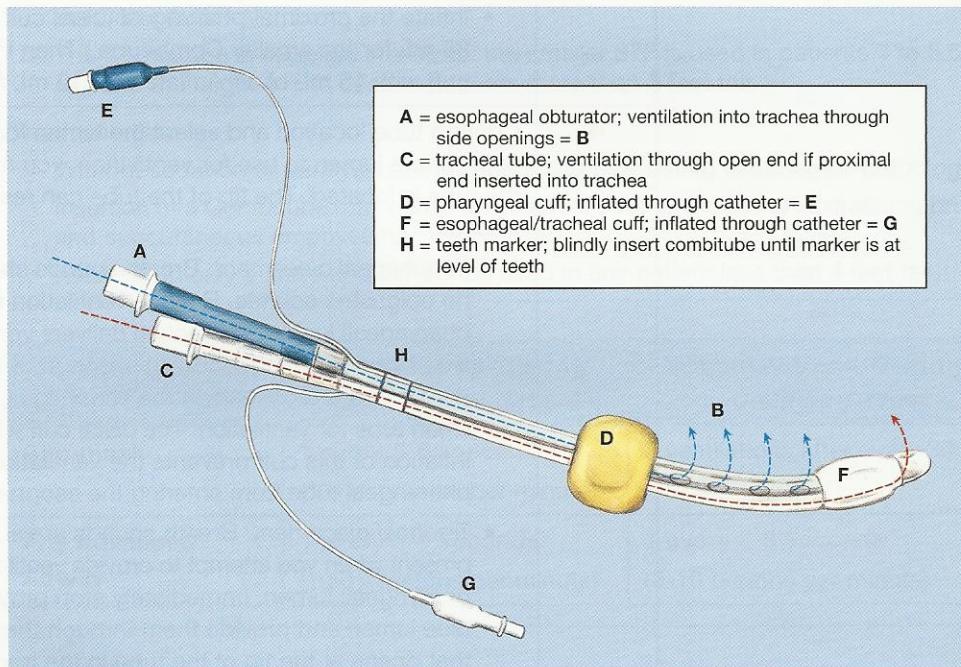
### **Ventilation Rates**

Airway Devices	Ventilations During Respiratory Arrest	Ventilations During Cardiac Arrest
Bag-mask	<b>1 every 5-6 seconds</b> (10-12 breaths per minute)	2 ventilations after every 30 compressions
Any Advanced Airway	<b>1 every 5-6 seconds</b> (10-12 breaths per minute)	<b>1 every 6-8 seconds</b> (8-10 breaths per minute)

# Esophageal-Tracheal Combitube

The Combitube is an invasive airway device with 2 inflatable balloon cuffs. It is inserted without visualization of the vocal cords. The tube is more likely to enter the esophagus than the trachea. When the tube does enter the esophagus, ventilation occurs through side openings adjacent to the vocal cords and trachea. If the tube enters the trachea, ventilation can still occur by an opening in the end of the tube.

Studies show that healthcare providers with all levels of experience can insert the Combitube and deliver ventilation comparable to that achieved with endotracheal intubation. Only providers trained and experienced with the use of the Combitube should insert the device because fatal complications are possible.



**Figure 10.** Esophageal-tracheal Combitube.

## When to Use

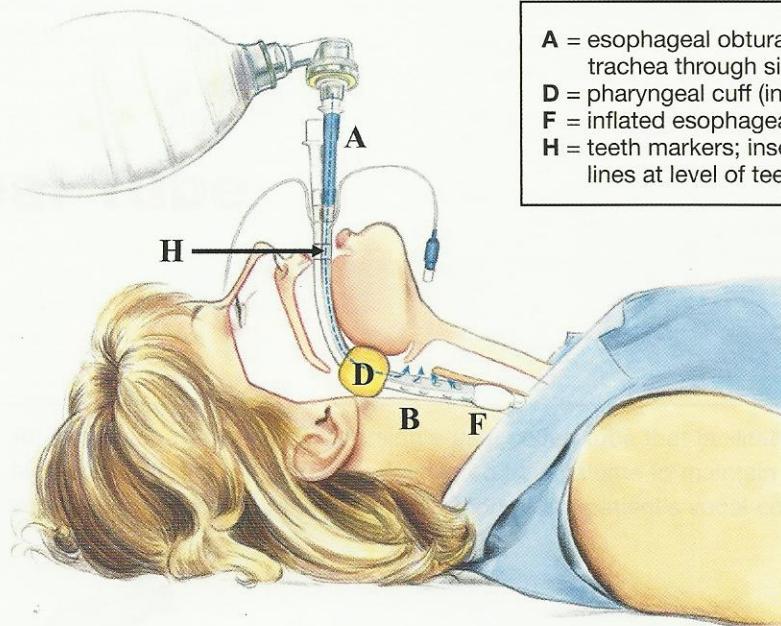
- Patient is unresponsive with no cough or gag reflex

## When Not to Use

- Patient is responsive
- Age younger than 16 years or height less than 4 feet
- Gag reflex present
- Known or suspected esophageal disease
- Ingestion of a caustic substance

## How to Use

Step	Action
1	<i>Equipment preparation:</i> Check the integrity of both cuffs according to the manufacturer's instructions and lubricate the tube.
2	<i>Patient preparation:</i> Provide oxygenation and ventilation, and position the patient. Rule out the contraindications to insertion of the Combitube (see When Not to Use above).
3	<i>Insertion technique:</i> <ul style="list-style-type: none"><li>• Hold the device with cuffs deflated so that the curvature of the tube matches the curvature of the pharynx.</li><li>• Lift the jaw and insert the tube gently until the black lines on the tube are positioned between the patient's teeth. (Do not force, and do not attempt for more than 30 seconds.)</li><li>• Inflate the proximal/pharyngeal (blue) cuff with 100 mL of air. (Inflate with 85 mL for the smaller Combitube.) Then inflate the distal (white or clear) cuff with 15 mL of air. (Inflate with 12 mL for the smaller Combitube.)</li></ul>
4	Confirm tube location and select the lumen for ventilation. To select the appropriate lumen to use for ventilation, you must determine where the tip of the tube is located. The tip of the tube can rest in either the esophagus or the trachea. <ul style="list-style-type: none"><li>• <i>Esophageal placement:</i> Breath sounds should be present bilaterally with no epigastric sounds. Provide ventilation through the blue (proximal/pharyngeal) lumen. This action delivers ventilation through the pharyngeal side holes between the 2 cuffs, and air will enter the trachea. Because the tip of the tube rests in the esophagus, do not use the distal (white or clear) tube for ventilation. The distal cuff will also lie within the esophagus; inflation of this cuff prevents the ventilations that you deliver through the pharyngeal tube from entering the esophagus.</li><li>• <i>Tracheal placement:</i> Breath sounds are absent and epigastric sounds are present when you attempt to provide ventilation through the blue (proximal/pharyngeal) lumen. Immediately stop providing ventilations through the blue lumen and provide them through the distal (white or clear) lumen that opens at the tip of the tube in the trachea. With endotracheal placement of the tube, the distal cuff performs the same function as a cuff on an ETT. Detection of exhaled CO<sub>2</sub> (through the ventilating white or clear lumen) should be used for confirmation, particularly if the patient has a perfusing rhythm.</li><li>• <i>Unknown placement:</i> Breath sounds and epigastric sounds are absent. Deflate both cuffs and withdraw the tube slightly, reinflate the blue cuff, and then reinflate the white (or clear) cuff (see steps above). If breath sounds and epigastric sounds are still absent, remove the tube.</li></ul>



**A** = esophageal obturator; ventilation into trachea through side openings = **B**  
**D** = pharyngeal cuff (inflated)  
**F** = inflated esophageal/tracheal cuff  
**H** = teeth markers; insert until marker lines at level of teeth

**Figure 11.** Esophageal-Tracheal Combitube.

### Cautions/Additional Information

- Do not apply cricoid pressure during insertion because it may hinder the insertion of the Combitube.
- The Combitube is supplied in 2 sizes: the smaller 37F is used in patients 4 to 5.5 feet tall, and the larger 41F is used in patients more than 5 feet tall.

Disadvantages:

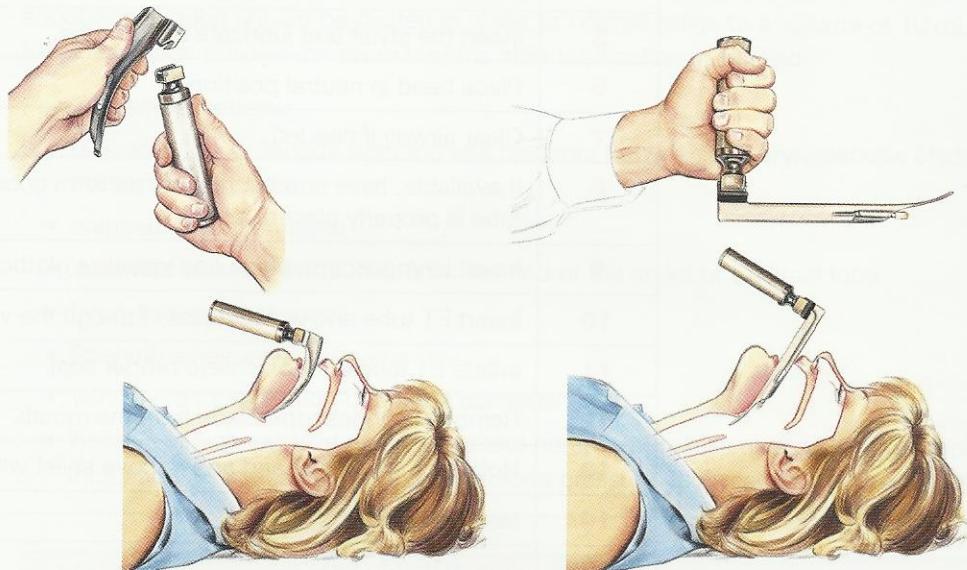
- Without sedation or paralysis, it may aggravate preexisting esophageal pathology.
- Insertion of a Combitube may cause esophageal trauma, including lacerations, bruising, and subcutaneous emphysema.
- Available in only 2 sizes and cannot be used in any patient less than 4 feet tall.

### Ventilation Rates

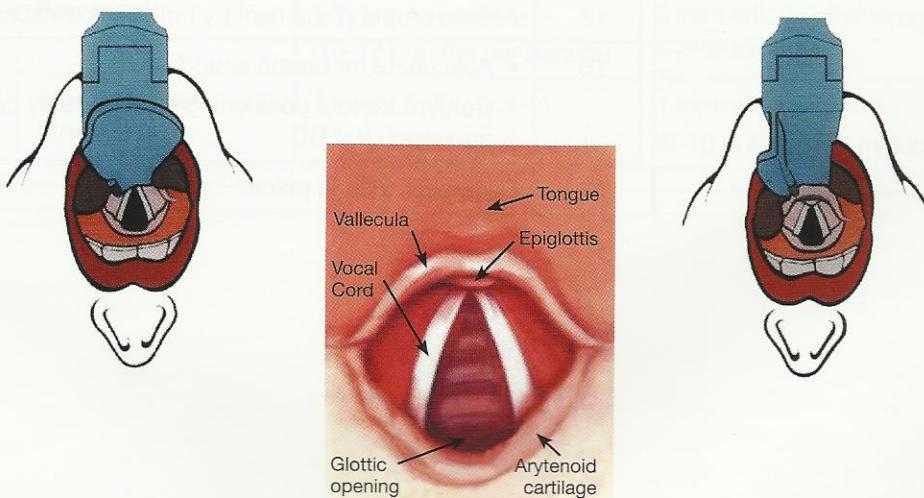
Airway Devices	Ventilations During Respiratory Arrest	Ventilations During Cardiac Arrest
Bag-mask	<b>1 every 5-6 seconds</b> (10-12 breaths per minute)	2 ventilations after every 30 compressions
Any Advanced Airway	<b>1 every 5-6 seconds</b> (10-12 breaths per minute)	<b>1 every 6-8 seconds</b> (8-10 breaths per minute)

## Endotracheal Tube

An endotracheal tube (ETT) is a single-use, cuffed tube that facilitates delivery of a high concentration of oxygen and selected tidal volume to maintain adequate ventilation; placement requires visualization of the patient's vocal cords.



**Figure 12.** Curved and straight blades.



**Figure 13.** View of vocal cords.

## When to Use

- Cardiac arrest when bag-mask ventilation is not possible or is ineffective
- Responsive patient in respiratory compromise is unable to oxygenate adequately despite noninvasive ventilatory measures
- Patient is unable to protect airway (eg, coma, areflexia, or cardiac arrest)

## When Not to Use

- Patient has a cough or gag reflex

## How to Use

Step	Action
1	Assemble and check all necessary equipment (ET tube and laryngoscope).
2	Choose appropriate size ET tube: in general, an 8 mm internal diameter tube is used for adult males, and a 7 mm internal diameter tube is used for adult females.
3	Choose appropriate type (straight or curved) and size laryngoscope blade.
4	Test ET tube cuff integrity.
5	Insert the stylet and lubricate the ET tube.
6	Place head in neutral position.
7	Clear airway if needed.
8	If available, have another rescuer perform cricoid pressure; maintain until ET tube is properly placed.
9	Insert laryngoscope blade and visualize glottic opening.
10	Insert ET tube and watch it pass through the vocal cords.
11	Inflate ET tube cuff to achieve proper seal.
12	Remove laryngoscope blade from the mouth.
13	Hold tube with one hand and remove stylet with other hand.
14	Insert bite block.
15	Attach bag to tube.
16	Squeeze the bag to give breaths (1 second each) while watching for chest rise.
17	Assess proper placement by both clinical assessment and device confirmation.
18	<ul style="list-style-type: none"><li>• Auscultate for breath sounds.</li><li>• Confirm correct positioning of ET tube by colorimetric ETCO<sub>2</sub>, capnograph, EDD.</li></ul>
19	Secure ET tube in place.

**Cautions/Additional Information**

- The incidence of complications is unacceptably high when intubation is performed by inexperienced providers or monitoring of tube placement is inadequate.
- Detailed assessment of out-of-hospital intubation attempts has concluded that endotracheal tubes are much more difficult to place properly in that setting and highly susceptible to dislodgment.
- Proper training, supervision, frequent clinical experience, and a process of continuous quality improvement are the keys to achieving successful intubation of patients while minimizing complications.
- For an adult, a No. 3 or No. 4 curved or straight blade is typically used.
- Remove patient's dentures if present to achieve endotracheal intubation.
- If IV or IO route of administration is not available, certain drugs (eg, epinephrine, vasopressin, atropine sulfate, and lidocaine) can be given via the endotracheal route.

Note for drugs that can be administered by the endotracheal route: Optimal endotracheal doses have not been established. IV/IO administration is preferred because it provides a more reliable drug delivery and pharmacologic effect. Medication delivered via the endotracheal tube should be diluted in water or normal saline to a volume of 10 mL. Provide several positive-pressure breaths after medication is instilled.

Possible complications:

- lacerated lips or tongue from forceful pressure between the laryngoscope blade and the tongue or cheek
- chipped or broken teeth
- lacerated pharynx or trachea from the end of the stylet or tracheal tube
- Injury to the vocal cords
- Pharyngeal-esophageal perforation
- Vomiting and aspiration of gastric contents
- Release of high levels of epinephrine and norepinephrine stimulated by endotracheal intubation, which can cause elevated blood pressure, tachycardia, or other arrhythmias

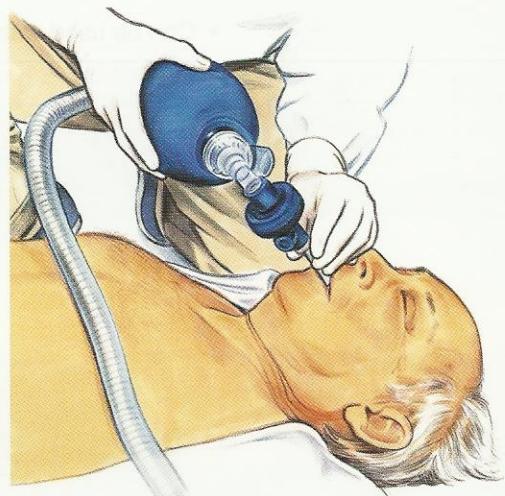
**Ventilation Rates**

Airway Devices	Ventilations During Respiratory Arrest	Ventilations During Cardiac Arrest
Bag-mask	<b>1 every 5-6 seconds</b> (10-12 breaths per minute)	2 ventilations after every 30 compressions
Any Advanced Airway	<b>1 every 5-6 seconds</b> (10-12 breaths per minute)	<b>1 every 6-8 seconds</b> (8-10 breaths per minute)

# Impedance Threshold Device

The impedance threshold device (ITD) is a valve that limits air entry into the lungs during chest recoil between chest compressions. It reduces pressure in the chest between compressions and enhances venous blood return to the heart.

The ITD has a ventilation port, a patient port, and ventilation timing lights that flash 10 times per minute when you turn the switch on. There is also a safety check valve that allows inspiration if the patient begins to breathe spontaneously.



**Figure 14.** Impedance threshold device.

**CPR=ITD  
No CPR=No ITD**

## When to Use

- Patient is in cardiac arrest (no pulse and no breathing)

## When Not to Use

- Patient is responsive
- Patient is breathing
- Patient is in respiratory arrest

## How to Use

Step	Action
1	Place ITD on face mask immediately at the start of CPR.
2	Ensure a continuously tight seal to the face during compressions and ventilations.
3	Once an advanced airway is in place, transfer the ITD to the advanced airway and turn on the ventilation timing lights.
4	Use ventilation timing device to ensure proper timing of ventilations.
5	If the patient experiences a return of spontaneous circulation, remove the ITD immediately; with reassess, immediately reattach the ITD.
6	If the ITD fills with fluid, remove the device, squeeze the bag to blow the fluid from the device, and then continue its use.

## Cautions/Additional Information

The effectiveness of the ITD depends on the quality of CPR provided: remember to compress the chest 1½ to 2 inches at a rate of 100 times per minute and allow complete chest recoil. Minimize interruptions in compressions and avoid hyperventilation. To maintain quality of compressions, rotate rescuers every 2 minutes.

- Can be used with a bag-mask device or with any advanced airway

## Appendix: Skills Station Competency Checklists

# Airway Skills Station Competency Checklist

## Bag-Mask Ventilation and Airway Adjuncts



Name: \_\_\_\_\_

Date: \_\_\_\_\_

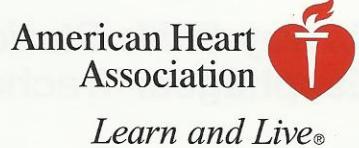
Critical Performance Steps	<input checked="" type="checkbox"/> if done correctly
Performs head tilt-chin lift	
Performs suctioning within 10 seconds	
Assembles bag and chooses appropriate size mask	
Chooses appropriate size OPA or NPA and inserts device	
Holds and seals mask with 1 hand	
Ventilates at proper rate (1 breath every 5 to 6 seconds)	
Produces noticeable chest rise	
Delivers each ventilation over 1 second	
Releases bag completely between ventilations	
Holds and seals mask correctly with 2 hands	
Applies cricoid pressure	

STOP THE TEST

Test Results	Indicate Pass (P) or Needs Remediation (NR):	P	NR
Facilitator signature affirms that student performed skill according to AHA guidelines. Save this sheet with course record.	Facilitator Signature: _____ Facilitator Name (print): _____ Date: _____		

# Airway Skills Station Competency Checklist

## Laryngeal Mask Airway



Name: \_\_\_\_\_

Date: \_\_\_\_\_

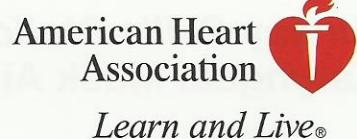
Critical Performance Steps	<input checked="" type="checkbox"/> if done correctly
Prepares and assembles all necessary equipment	
Chooses appropriate size LMA	
Tests integrity of cuff by inflating it	
Deflates cuff on a flat surface and lubricates LMA on posterior surface only for use	
Opens and clears airway	
Places head in neutral or sniffing position	
Inserts LMA into oropharynx and advances it	
Inflates cuff to achieve proper seal; removes syringe	
Produces noticeable chest rise; auscultates breath sounds (if using a feedback manikin)	
Inserts bite block or bite stick	
Secures LMA in place	
Performs correct ventilation rate for respiratory arrest (1 breath every 5 to 6 seconds)	
Performs correct ventilation rate for cardiac arrest (1 breath every 6 to 8 seconds)	
Delivers each ventilation over 1 second	
Demonstrates complete release of bag between ventilations	

STOP THE TEST

Test Results	Indicate Pass (P) or Needs Remediation (NR):	P	NR
Facilitator signature affirms that student performed skill according to AHA guidelines. Save this sheet with course record.	Facilitator Signature: _____ Facilitator Name (print): _____ Date: _____		

# Airway Skills Station Competency Checklist

## Esophageal-Tracheal Combitube



Name: \_\_\_\_\_

Date: \_\_\_\_\_

Critical Performance Steps	<input checked="" type="checkbox"/> if done correctly
Prepares and assembles all necessary equipment	
Chooses appropriate size device	
Tests cuff integrity (blue 100 mL, white 15 mL), then deflates	
Lubricates tube	
Opens and clears airway	
Places head in neutral or sniffing position	
Inserts device into mouth and advances to correct depth	
Inflates balloons; removes syringes	
Produces noticeable chest rise; auscultates breath sounds (if using a feedback manikin)	
Secures Combitube in place	
Performs correct ventilation rate for respiratory arrest (1 breath every 5 to 6 seconds)	
Performs correct ventilation rate for cardiac arrest (1 breath every 6 to 8 seconds)	
Delivers each ventilation over 1 second	
Demonstrates complete release of bag between ventilations	

**STOP THE TEST**

Test Results	Indicate Pass (P) or Needs Remediation (NR):	P	NR
Facilitator signature affirms that student performed skill according to AHA guidelines. <i>Save this sheet with course record.</i>	Facilitator Signature: _____ Facilitator Name (print): _____ Date: _____		

# Airway Skills Station Competency Checklist

## Endotracheal Tube



Learn and Live®

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Critical Performance Steps	<input checked="" type="checkbox"/> if done correctly
Assembles and checks all necessary equipment	
Chooses appropriate size ET tube	
Chooses appropriate type (straight or curved) and size laryngoscope blade	
Tests ET tube cuff integrity	
Inserts the stylet and lubricates the ET tube	
Places head in neutral or sniffing position	
Clears airway if needed	
Inserts laryngoscope blade	
Inserts ET tube to proper length for gender	
Inflates ET tube cuff to achieve proper seal; removes syringe	
Inserts bite block (if not using a commercial device)	
Produces noticeable chest rise; auscultates breath sounds (if using a feedback manikin)	
Confirms correct positioning of ET tube by colorimetric ETCO <sub>2</sub> , capnograph, EDD	
Secures ET tube in place (commercial device or tape)	
Performs correct ventilation rate for respiratory arrest (1 breath every 5 to 6 seconds)	
Performs correct ventilation rate for cardiac arrest (1 breath every 6 to 8 seconds)	
Delivers each ventilation over 1 second	
Demonstrates complete release of bag between ventilations	

STOP THE TEST

Test Results	Indicate Pass (P) or Needs Remediation (NR):	P	NR
Facilitator signature affirms that student performed skill according to AHA guidelines. Save this sheet with course record.	Facilitator Signature: _____ Facilitator Name (print): _____ Date: _____		

# Airway Skills Station Competency Checklist

## Impedance Threshold Device



Learn and Live®

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Critical Performance Steps	<input checked="" type="checkbox"/> if done correctly
<i>Three rescuers are performing CPR, one doing compressions and two giving ventilations. Test student holding mask to face during ventilations.</i>	
Places the ITD on the mask immediately at the start of CPR	
Demonstrates continuously tight seal with mask during both compressions and ventilations	
<i>Advanced airway placed by facilitator, or students move to manikin with advanced airway in place.</i>	
Transfers ITD from mask to advanced airway	
Turns on ventilation timing lights	
Ventilates at a rate of 10 breaths per minute, each ventilation over 1 second	
<i>Facilitator prompts student: "Return of spontaneous circulation has occurred. Stop CPR."</i>	
Removes the ITD immediately	
<i>Facilitator prompts student: "Patient has re-arrested. Resume CPR." Compressor resumes compressions.</i>	
Places ITD back in the airway circuit immediately	
Ventilates at a rate of 10 breaths per minute, each ventilation over 1 second	
<i>Facilitator prompts student: "ITD begins to fill with fluid."</i>	
Clears device of fluid	

STOP THE  
TEST

Test Results	Indicate Pass (P) or Needs Remediation (NR):	P	NR
Facilitator signature affirms that student performed skill according to AHA guidelines. Save this sheet with course record.	Facilitator Signature: _____ Facilitator Name (print): _____ Date: _____		

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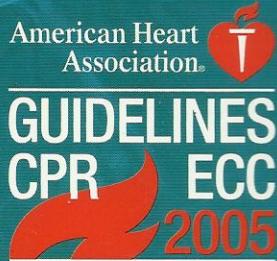
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